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(54) **Glycopeptide antibiotic amide derivatives**

(57) The present invention is directed to amides of antibiotic A82846B (also known as chloroorienticin A), and of N<sup>4</sup>-derivatives of A82846B. The present amide compounds are useful as antibacterials, especially for

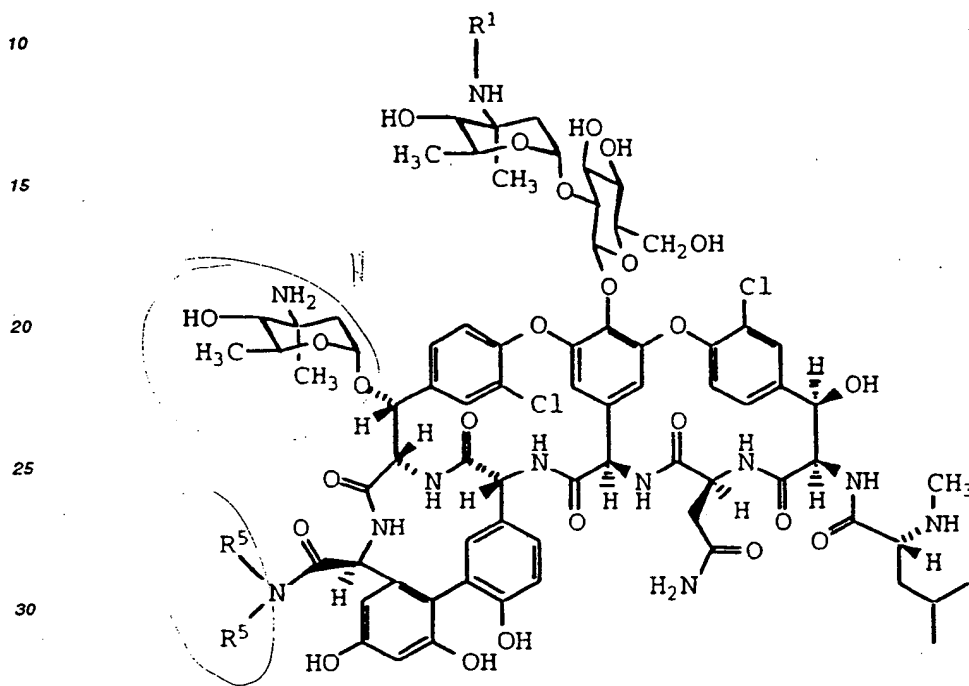
the control of gram positive bacteria; the compounds are particularly useful for the control of resistant bacterial strains, such as vancomycin-resistant-enterococci ("VRE").

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### Description

The present invention is directed to glycopeptide amides, more particularly to amides of antibiotic A82846B, also known as chloroorienticin A, and of N<sup>4</sup>-derivatives of A82846B. These amides are useful as antibacterials, especially for the control of gram positive bacteria; the compounds are particularly useful for the control of resistant bacterial strains, such as vancomycin-resistant-enterococci ("VRE").

The compounds of the present invention are defined by Formula I:



wherein R<sup>1</sup> is:

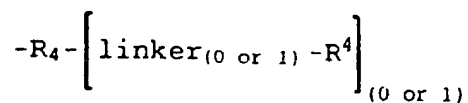
hydrogen or  $-\text{CH}_2\text{R}^2$ ;

wherein  $R^2$  is:

hydrogen,  
alkyl of C<sub>1</sub>-C<sub>15</sub>,  
alkenyl of C<sub>2</sub>-C<sub>15</sub>,  
alkynyl of C<sub>2</sub>-C<sub>15</sub>,  
haloalkyl of C<sub>1</sub>-C<sub>7</sub>,  
acenaphthenyl,  
2-fluorenyl,  
9,10-dihydro-2-phenanthrenyl,

R<sup>3</sup>,  
alkyl of C<sub>1</sub>-C<sub>11</sub>-R<sup>3</sup>,  
alkenyl of C<sub>2</sub>-C<sub>7</sub>-R<sup>3</sup>,  
alkynyl of C<sub>2</sub>-C<sub>7</sub>-R<sup>3</sup>, or  
alkyl of C<sub>1</sub>-C<sub>7</sub>-O-R<sup>3</sup>,

wherein R<sup>3</sup> is a radical of the formula:



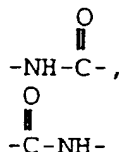
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wherein each  $R^4$  independently represents phenyl, cycloalkyl of  $C_5-C_6$ , naphthyl, or thienyl, each of which is unsubstituted or is optionally substituted with one or two substituents, each of which is independently alkyl of  $C_1-C_{10}$ , haloalkyl of  $C_1-C_2$ , haloalkoxy of  $C_1-C_2$ , alkoxy of  $C_1-C_{10}$ , halo, cyano, or nitro; and "linker" is:

10

- alkylene of  $C_1-C_3$ ,
- O-alkylene of  $C_1-C_6$ ,
- 15 - alkylene of  $C_1-C_6-O$ ,
- O-
- N(H or loweralkyl of  $C_1-C_3$ )-
- S-
- SO-
- 20 - SO<sub>2</sub>-

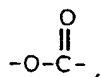
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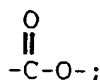
- CH=CH-
- C≡C-
- N=N-

35



or

40



45

and wherein  $R^5$  is defined as follows:

50

- (1) each  $R^5$  independently represents hydrogen,
- cycloalkyl of  $C_5-C_6$ ,
  - cycloalkenyl of  $C_5-C_6$ ,
  - phenyl or substituted phenyl bearing from one to three substituents, each of which is independently halo,
  - nitro,
  - loweralkyl of  $C_1-C_4$ ,
  - 55 cycloalkyl of  $C_5-C_6$ ,
  - loweralkoxy of  $C_1-C_4$ ,
  - haloloweralkyl of  $C_1-C_4$ , or haloloweralkoxy of  $C_1-C_4$ ;
  - naphthyl,

biphenyl,

radical of the formula  $-R^6-(R^7)_0, 1, \text{ or } 2$ , wherein  $R^6$  is loweralkyl of  $C_1-C_8$  optionally substituted by from one to three substituents, each of which is independently selected from the group consisting of halo, nitro, cyano, loweralkoxy of  $C_1-C_4$ , haloloweralkyl of  $C_1-C_4$ , and haloloweralkoxy of  $C_1-C_4$ ; and  $R^7$  is



wherein each  $R^8$  is independently hydrogen or loweralkyl of  $C_1-C_4$  or one  $R^8$  is hydrogen and the other  $R^8$  is tert-butoxycarbonyl, or  $R^7$  is phenyl or substituted phenyl as defined above, or

(2) one  $R^8$  is hydrogen and the other  $R^8$  is (2-furanon-3-yl); or

(3) both  $R^8$ s are taken together with the nitrogen and constitute a five- to seven-membered heterocyclic ring optionally containing in addition to the indicated nitrogen atom one additional hetero ring atom which is nitrogen, oxygen, or sulfur, and which heterocyclic radical can be unsubstituted or substituted with from one or two substituents, each of which is loweralkyl of  $C_1-C_2$ , loweralkoxy of  $C_1-C_2$ , phenyl, benzyl, or  $C_1-C_6$ -alkanoyl; or a salt thereof.

Certain compounds of the present invention are preferred. Amides of A82846B derivatives ( $R^1=-CH_2R^2$ ) generally exhibit antibacterial activity at concentrations lower than the amides of A82846B itself ( $R^1=H$ ).

Antibacterial activity is further enhanced by employing certain  $-CH_2R^2$  groups such as the following:

(4-phenylbenzyl)

(4-(4-chlorophenyl)benzyl)

(4-(4-methylphenyl)benzyl)

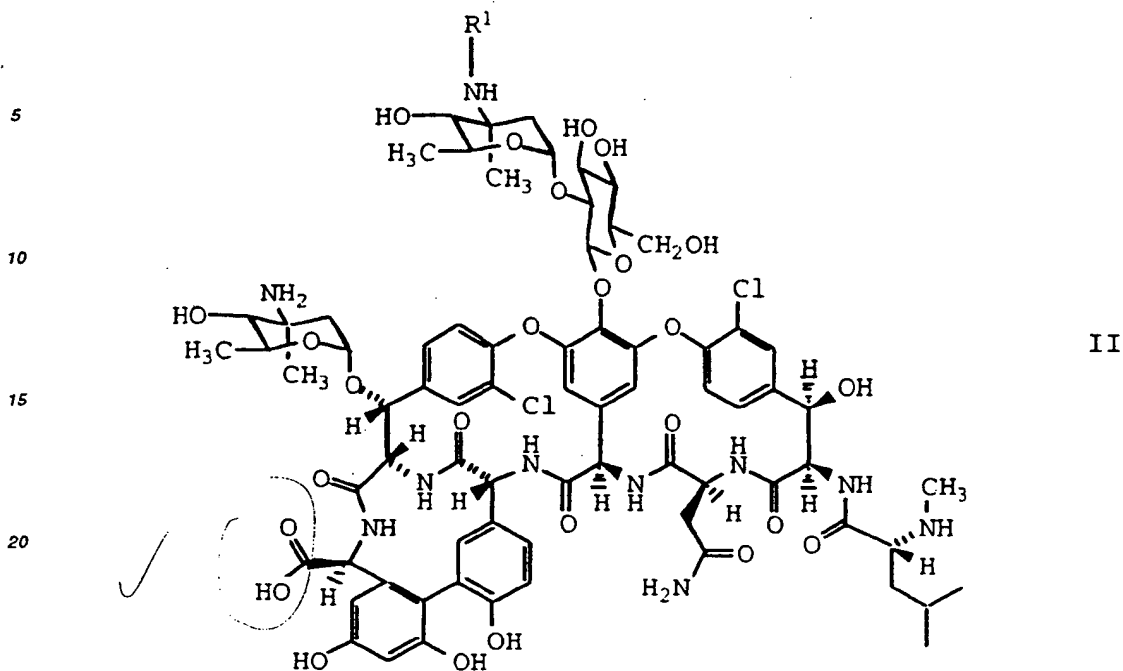
(4-phenoxybenzyl)

((4-n-butylphenyl)benzyl)

(4-benzylbenzyl)

Primary amines ( $H_2N-R_5$ ) may sometimes be preferred, for availability of starting materials and convenience of synthesis. Compounds wherein  $R^2=R^3$  are also preferred. Other preferences will be apparent from the further teachings herein.

The compounds of the present invention are prepared by reacting A82846B ( $R^1=hydrogen$ ) or an  $N^4$ -derivative thereof ( $R^1=-CH_2R^2$ ), defined by Formula II:



with an amine of the formula



The Formula II compounds are known or prepared in standard procedures. AB2846B ( $\text{R}^1 = \text{hydrogen}$ ) is the subject of U.S. Patent 5,312,738. The derivatives, those compounds of Formula II wherein  $\text{R}^1$  is  $-\text{CH}_2\text{R}^2$ , are prepared from AB2846B by reductive alkylation. AB2846B is initially reacted with an aldehyde to form an intermediate Schiff's base, which is subsequently reduced to obtain the desired Formula II compound. Alkylation at the  $\text{N}^4$  position, in preference to other reactive sites in the molecule, is favored by supplying a source of soluble copper. Copper (II) acetate is a preferred source of copper. The copper is preferably supplied in an amount equimolar with the AB2846B. Examples of the Formula II compounds are to be found in EPO 667,353, published August 16, 1995.

The reaction of Formula II compounds and amines of the formula



yields the compounds of the present invention. The reaction conditions are not critical. The reaction proceeds well when carried out in a solvent such as DMF, DMSO, or a mixture of DMF and DMSO, and at reaction temperatures of 0 to 100°C, although the reaction is conveniently conducted at room temperature. Generally, the reaction is conducted with equimolar proportions of the reactants or an excess of the amine.

The reaction is facilitated by the use of a coupling agent, such as:

- a) benzotriazol-1-yloxy-tripyrrolidinophosphonium hexafluorophosphate, one form of which is sold under the trademark PyBOP® (Calbiochem-Novabiochem AG);
- b) benzotriazol-1-yloxytris(dimethylamino)phosphonium hexafluorophosphate ("BOP");
- c) 0-benzotriazol-1-yl-N,N,N',N'-tetramethyluronium hexafluorophosphate ("HBTU");
- d) 1,3-dicyclohexylcarbodiimide ("DCC"), alone or in combination with 1-hydroxybenzotriazole hydrate ("HOBT");
- e) N,N'-dicyclohexyl-4-morpholinecarboxamidine ("WSC"); and
- f) (2-ethoxy-1-ethoxycarbonyl)-1,2-dihydroquinoline ("EEDQ").

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The first listed of these is preferred. In general, the coupling agent is supplied in an equimolar amount or in an excess.

The product can be isolated by precipitation or by lyophilization of the reaction mixture, and purified if desired in a conventional manner, such as by HPLC. Characterization of products is best accomplished by Fast Atom Bombardment Mass Spectroscopy (FAB•MS).

When it is desired to employ a salt, a compound of the present invention can be reacted with a mineral or organic acid, in techniques well known to those skilled in the art. Pharmaceutically-acceptable salts are preferred.

The following example reports the preparation of an exemplary compound of the present invention.

### Example 1:

#### N<sup>4</sup>-(4-PHENOXYBENZYL)A82846B, 3-(DIMETHYLAMINO)PROPYLAMIDE, TRIFLUOROACETATE SALT

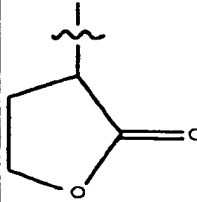
A mixture of N<sup>4</sup>-(4-phenoxybenzyl)A82846B, trifluoroacetate salt, (0.668 g, 0.376 mmol, 1.0 equivalent) in 25 ml dimethylsulfoxide (DMSO) under an atmosphere of argon was treated with 3-(dimethylamino)propylamine (0.038 g, 0.376 mmol, 1.0 eq.) and benzotriazol-1-yloxytripyrrolidinophosphonium hexafluorophosphate (PyBOP®) (0.196 g, 0.376 mmol, 1.0 eq.). The mixture was stirred at room temperature for 1 hour, diluted with 100 ml H<sub>2</sub>O, and lyophilized to give a solid.

The analytical method for analysis was 15% CH<sub>3</sub>CN/0.1% TFA at time 0 to 80% CH<sub>3</sub>CN/0.1% TFA at 15 minutes. The UV wavelength used was 235 nm and the flow rate 2 ml/minute. Analysis was done using a Waters Nova-pak C18 RCM column (8 x 100 mm) with a Nova-pak C18 guard insert. The solid was purified by preparative reverse-phase high performance liquid chromatography (HPLC) using a Waters 3 x (40 x 100 mm) C18 Nova-pak cartridge with Waters C18 Nova-pak guard insert and utilizing a TFA buffer system. The desired fraction was lyophilized to give the trifluoroacetate salt, a white solid (0.455 g, 55%). The product was characterized by FAB•MS, (M+3H), 1860.

Other products of the present invention were prepared as in Example 1 or with some modifications of the procedure. Modifications included varying the solvent, providing a longer reaction time, up to 123 hours, increasing the amount of amine and/or coupling agent up to 5 equivalents, and using the compound of Formula I as a free base. The reaction appeared to work best with DMSO, but DMF was easier to remove. The reaction was analyzed by HPLC to determine if product was present; if the reaction was incomplete, more amine (1-5 eq) and coupling agent (1-5 eq) were added with solvent and the reaction was continued from 3.5 hours to 48 hours longer.

Other examples of the present invention are listed in Table 1.

TABLE I

Ex. No.	R <sup>5</sup>	R <sup>1</sup>	Name	Yield	Mass Spec. FAB-MS (M+3H)
2	CH <sub>3</sub> -	4-phenylbenzyl	N <sup>4</sup> -(4-phenylbenzyl)A82846B, methylamide, trifluoroacetate salt	52	1773
3	n-C <sub>4</sub> H <sub>9</sub> -	4-phenylbenzyl	N <sup>4</sup> -(4-phenylbenzyl)A82846B, n-butylamide, trifluoroacetate salt	19	1814
4	(CH <sub>3</sub> ) <sub>3</sub> -C-	4-phenylbenzyl	N <sup>4</sup> -(4-phenylbenzyl)A82846B, tert-butylamide, trifluoroacetate salt	38	1814
5	(CH <sub>3</sub> ) <sub>3</sub> -C-	4-phenoxybenzyl	N <sup>4</sup> -(4-phenoxybenzyl)A82846B, tert-butylamide, trifluoroacetate salt	8.5	1831
6	n-C <sub>8</sub> H <sub>17</sub> -	4-phenoxybenzyl	N <sup>4</sup> -(4-phenoxybenzyl)A82846B, n-octylamide, trifluoroacetate salt	27	1885
7	DL 	4-phenylbenzyl	N <sup>4</sup> -(4-phenylbenzyl)A82846B, DL-(2-furanon-3-yl)amide	20	1841
8	4-cyclohexylphenyl	4-phenylbenzyl	N <sup>4</sup> -(4-phenylbenzyl)A82846B, (4-cyclohexylphenyl)amide, trifluoroacetate salt	8	1915

9	benzyl	4-phenoxybenzyl	N <sup>4</sup> -(4-phenoxybenzyl)A82846B, benzylamide, trifluoroacetate salt	30	1864
10	benzyl	4-phenylbenzyl	N <sup>4</sup> -(4-phenylbenzyl)A82846B, benzylamide	47	1849
11	benzyl	4-phenylbenzyl	N <sup>4</sup> -(4-phenylbenzyl)A82846B, benzylamide, HCl salt		
12	4-methoxybenzyl	4-phenylbenzyl	N <sup>4</sup> -(4-phenylbenzyl)A82846B, (4-methoxybenzyl)amide, trifluoroacetate salt	43	1878
13	3-methoxypropyl	4-phenylbenzyl	N <sup>4</sup> -(4-phenylbenzyl)A82846B, (3-methoxypropyl)amide	N.D.	1830
14	phenethyl	4-phenoxybenzyl	N <sup>4</sup> -(4-phenoxybenzyl)A82846B, phenethylamide, trifluoroacetate salt	27	1880
15	phenethyl	(4-n-butylbenzyl)	N <sup>4</sup> -(4-n-butylbenzyl)A82846B, phenethylamide, trifluoroacetate salt	N.D.	1842
16	phenethyl	hydrogen	A82846B, phenethylamide, trifluoroacetate salt	27	1696
17	phenethyl	4-phenylbenzyl	N <sup>4</sup> -(4-phenylbenzyl)A82846B, phenethylamide	58	1862
18	phenethyl	4-phenylbenzyl	N <sup>4</sup> -(4-phenylbenzyl)A82846B, phenethylamide, HCl salt	37	1862
19	phenethyl	4-(4-methylphenyl)-benzyl	N <sup>4</sup> -(4-(4-methylphenyl)benzyl)-A82846B, phenethylamide	15	1875
20	3-phenyl-n-propyl	hydrogen	A82846B, (3-phenyl-n-propyl)amide	N.D.	1710
21	(CH <sub>3</sub> ) <sub>2</sub> N-CH <sub>2</sub> -CH <sub>2</sub> -	4-phenylbenzyl	N <sup>4</sup> -(4-phenylbenzyl)A82846B, (3-(dimethylamino)-n-propyl)amide	26	1844



22	3,3-diphenyl-n-propyl	4-phenylbenzyl	N <sup>4</sup> -(4-phenylbenzyl)A82846B, (3,3-diphenyl-n-propyl)amide	16	1953
23	(CH <sub>3</sub> ) <sub>2</sub> N-CH <sub>2</sub> -CH <sub>2</sub> -	hydrogen	A82846B, (3-(dimethylamino)-n-propyl)amide, trifluoroacetate salt	19	1678
24	benzyl	hydrogen	A82846B, benzylamide, trifluoroacetate salt	48	1682
25	5-(tert-butoxycarbonylamino)-pentyl	4-(4-chlorophenyl)-benzyl	N <sup>4</sup> -(4-(4-chlorophenyl)benzyl)-A82846B, 5-(tert-butoxycarbonylamino)-pentylamide, tris(trifluoroacetate) salt	21	1976
26	5-aminopentyl	4-(4-chlorophenyl)-benzyl	N <sup>4</sup> -(4-(4-chlorophenyl)benzyl)A82846B, 5-aminopentylamide, tetra(trifluoroacetate) salt	61	1878

The invention is further illustrated by Examples 25 and 26.

Example 25:

5 N<sup>4</sup>-(4-(4-CHLOROPHENYL)BENZYL)A82846B, 5-(TERT-BUTOXYCARBONYLAMINO)PENTYLAMIDE, TRIS (TRIFLUOROACETATE) SALT

10 A mixture of N<sup>4</sup>-(4-(4-chlorophenyl)benzyl)A82846B, diphosphate salt (0.5 g, 0.251 mmol, 1.0 equivalent) in 8 ml dimethylformamide (DMF) and 4 ml dimethylsulfoxide (DMSO) under an atmosphere of nitrogen was treated with benzotriazol-1-yloxytripyrrolidinophosphonium hexafluorophosphate (PyBop®) (0.261 g, 0.502 mmol, 2.0 eq), N,N-diisopropylethylamine (0.097 g, 131 µl, 0.75 mmol, 3.0 eq), and N-(tert-butoxycarbonylamino)-1,5-diaminopentane (105 µl, 0.50 mmol, 2 eq). The mixture was stirred at room temperature for 5 days, then diluted with 80 ml acetone to produce a precipitate. The solid was collected by filtration to yield 526 mg of crude solid.

15 The analytical method for analysis was 100/0-25/75%, A/B over 30 minutes (A-0.1% TFA, 5% acetonitrile in water and B-acetonitrile). The UV wavelength used was 235 nm and the flow rate was 2 ml/minute. Analysis was done using a Waters µ bondapak™ C18 column (3.9 X 300 mm, 10 µm, 125 Å).

20 The solid was purified by preparative reverse-phase high performance liquid chromatography (HPLC) on a Waters Prep 2000 system using a Waters Nova-pak® C18 cartridge [3 X (40 X 100 mm), 6 µm, 60 Å] with a Waters Nova-pak® C18 guard insert. The solvent system utilized was 0/100-75/25, B/C over 30 minutes (B-acetonitrile and C=0.1% TFA, 5% acetonitrile in water). The UV wavelength used was 235 nm and the flow rate was 50 ml/minute. The titled product was isolated (125 mg, 21% yield) and characterized by FAB-MS: calcd for C<sub>36</sub>H<sub>41</sub>ClN<sub>5</sub>O<sub>7</sub> 1974.7, found 1976.2 (M+2H).

Example 26:

25 N<sup>4</sup>-(4-(4-CHLOROPHENYL)BENZYL)A82846B, 5-AMINOPENTYLAMIDE, TETRA(TRIFLUOROACETATE) SALT

30 A mixture/suspension of N<sup>4</sup>-(4-(4-chlorophenyl)benzyl) A82846B, 5-(tert-butoxycarbonylamino)pentylamide, tris (trifluoroacetate) salt, 0.125 g, 0.0539 mmol, 1 eq) in 15 ml dichloromethane was treated with trifluoroacetic acid (500 µl, 6.49 mmol, 120.4 eq) at 0°C. The reaction was stirred and allowed to warm to room temperature over 2.25 hours. A residue adhered to the side of the flask and was dissolved by adding methanol. The solvents were removed under vacuum and the residue was azeotroped with toluene (2X) to yield a white solid. The solid was analyzed and purified as above to yield the titled product (77 mg, 61% yield). The material was characterized by FAB-MS: calcd for C<sub>31</sub>H<sub>40</sub>ClN<sub>5</sub>O<sub>2</sub> 1874.7, found 1877.7 (M+3).

35 The compounds of Formula I are useful for the treatment of bacterial infections. Therefore, in another embodiment, the present invention is directed to a method for controlling a bacterial infection in a host animal, typically a warm-blooded animal, which comprises administering to the host animal an effective, antibacterial amount of a compound of Formula I. In this embodiment, the compounds of the present invention can be used to control and treat infections due to various bacteria, but especially gram-positive bacteria. In a preferred embodiment, the compounds are used to control and treat infections due to bacteria resistant to existing antibacterials. For example, certain bacteria are resistant to methicillin, and yet others are resistant to vancomycin and/or teicoplanin. Strains of *Enterococcus* resistant to vancomycin are referred to as "VRE" (vancomycin-resistant *Enterococcus*); these strains represent a serious problem, especially in nosocomial settings. The present compounds provide a technique for controlling and treating infections due to VRE.

45 In carrying out this embodiment of the invention, the compounds can be administered by any of the conventional techniques, including the oral route and parenteral routes such as intravenous and intramuscular. The amount of compound to be employed is not critical and will vary depending on the particular compound employed, the route of administration, the severity of the infection, the interval between dosings, and other factors known to those skilled in the art. In general, a dose of from about 0.5 to about 100 mg./kg. will be effective; and in many situations, lesser doses of from about 0.5 to about 50 mg./kg. will be effective. A compound of the present invention can be administered in a single dose, but in the known manner of antibacterial therapy, a compound of the present invention is typically administered repeatedly over a period of time, such as a matter of days or weeks, to ensure control of the bacterial infection.

50 Also in accordance with known antibacterial therapy, a compound of the present invention is typically formulated for convenient delivery of the requisite dose. Therefore, in another embodiment, the present invention is directed to a pharmaceutical formulation comprising a compound of Formula I, in combination with a pharmaceutically-acceptable diluent or carrier. Such diluents and carriers are well known for both oral and parenteral routes of delivery. In general, a formulation will comprise a compound of the present invention in a concentration of from about 0.1 to about 90% by weight, and often from about 1.0 to about 3%.

The antibacterial efficacy of the present compounds is illustrated in TABLE 2. The minimal inhibitory concentrations (MICs) were determined using a standard broth micro-dilution assay.

TABLE 2  
Enterococcus Screen, Minimum Inhibitory Concentrations (MICs)  
Selected Individual Pathogens\*

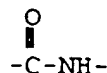
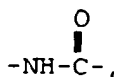
Ex. #	Mean Values of 4-6 Isolates													
	Resistant	Sensitive	SA 446	SA 489	SA 447	SH105	SH415	SE270	S PN P1	S PY 203				
1	1.4	0.13	4	2	1	2	2	0.25	20.125	20.06				
2	1.19	0.041	1	1	0.5	0.125	0.25	20.06	20.06	20.06				
3	2.4	0.11	2	4	2	0.5	2	1	20.06	20.06				
4	2	0.082	2	1	0.5	1	2	0.125	20.06	20.06				
5	4	0.22	8	2	2	4	2	4		20.06				
6	1.7	0.44	4	2	1	1	4	1		20.06				
7	1.7	0.048	2	1	2	0.5	1	0.5	20.06	20.06				
8	6.7	0.33	2	4	2	4	4	2	20.06	20.06				
9	2	0.082	1	1	1	1	1	0.5	20.06	20.06				
10	0.84	0.14	1	4	2	0.5	4	0.5	20.06	20.06				
11	1	0.11	4	1	1	1	1	1	20.06	20.06				
12	1.7	0.13	2	0.5	1	1	4	2	20.06	20.06				
13	1.4	0.072	1	1	1	2	0.5	1	20.06	20.06				
14	2	0.01	2	1	2	0.5	2	1	20.06	20.06				
15	1.7	0.22	2	2	2	1	2	2	20.06	20.06				
16	16	0.25	0.125	20.06	20.06	20.06	0.125	20.06	20.06	20.06				
17	1.4	0.25												
18	0.84	0.19	1	2	1	2	2	1	20.06	20.06				
19	1	0.22	2	2	4	2	4	2	20.06	20.06				
20	11	0.22	0.125	20.06	20.06	0.125	0.25	20.06	20.06	20.06				
21	1.2	0.054	4	2	2	0.5	2	0.5	20.06	20.06				
22	1.68	0.87	32	32	32	8	8	16	0.125	0.125				
23	>128	0.44	0.125	20.06	0.125	20.06	20.06	20.06	20.06	20.06				
24	>128	0.38	20.06	20.06	20.06	20.06	20.06	20.06	20.06	20.06				
25	2.8	5.0												
26	1.7	0.44	2	2	1	0.5	2	1	0.25	0.25				

\* SA 446 = *Staphylococcus aureus* 446  
 SA 489 = *Staphylococcus aureus* 489  
 SA 447 = *Staphylococcus aureus* 447  
 SH 105 = *Staphylococcus haemolyticus* 105  
 SH 415 = *Staphylococcus haemolyticus* 415  
 SE 270 = *Staphylococcus epidermis* 270  
 S PN P1 = *Streptococcus pneumoniae* P1  
 S PY 203 = *Streptococcus pyogenes* 203

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wherein each  $R^4$  independently represents phenyl, cycloalkyl of  $C_5-C_6$ , naphthyl, or thienyl, each of which is unsubstituted or is optionally substituted with one or two substituents, each of which is independently alkyl of  $C_1-C_{10}$ , haloalkyl of  $C_1-C_2$ , haloalkoxy of  $C_1-C_2$ , alkoxy of  $C_1-C_{10}$ , halo, cyano, or nitro; and "linker" is:

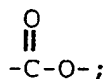
- alkylene of  $C_1-C_3$ ,
- O-alkylene of  $C_1-C_6$ ,
- alkylene of  $C_1-C_6-O$ ,
- O-
- N(H or loweralkyl of  $C_1-C_3$ )-,
- S-
- $SO$ -
- $SO_2$ -



- $\text{CH=CH-}$ ,
- $\text{C}\equiv\text{C-}$ ,
- $\text{N=N-}$ ,



or



and wherein  $R^5$  is defined as follows:

(1) each  $R^5$  independently represents

- hydrogen,
- cycloalkyl of  $C_5-C_6$ ,
- cycloalkenyl of  $C_5-C_6$ ,
- phenyl or substituted phenyl bearing from one to three substituents, each of which is independently halo,
- nitro,
- loweralkyl of  $C_1-C_4$ ,
- cycloalkyl of  $C_5-C_6$ ,
- loweralkoxy of  $C_1-C_4$ ,
- haloloweralkyl of  $C_1-C_4$ , or
- haloloweralkoxy of  $C_1-C_4$ ;
- naphthyl,
- biphenyl,
- radical of the formula  $-R^6-(R^7)_0$ , 1, or 2, wherein  $R^6$  is loweralkyl of  $C_1-C_8$  optionally substituted by from one to three substituents, each of which is independently selected from the group consisting of halo, nitro,

## Claims

1. A compound of the formula:

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wherein R<sup>1</sup> is:

hydrogen or -CH<sub>2</sub>R<sup>2</sup>,

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wherein R<sup>2</sup> is:

hydrogen,

alkyl of C<sub>1</sub>-C<sub>15</sub>,

alkenyl of C<sub>2</sub>-C<sub>15</sub>,

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alkynyl of C<sub>2</sub>-C<sub>15</sub>,

haloalkyl of C<sub>1</sub>-C<sub>7</sub>,

acenaphthenyl,

2-fluorenyl,

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9,10-dihydro-2-phenanthrenyl,

R<sup>3</sup>,

alkyl of C<sub>1</sub>-C<sub>11</sub>-R<sup>3</sup>,

alkenyl of C<sub>2</sub>-C<sub>7</sub>-R<sup>3</sup>,

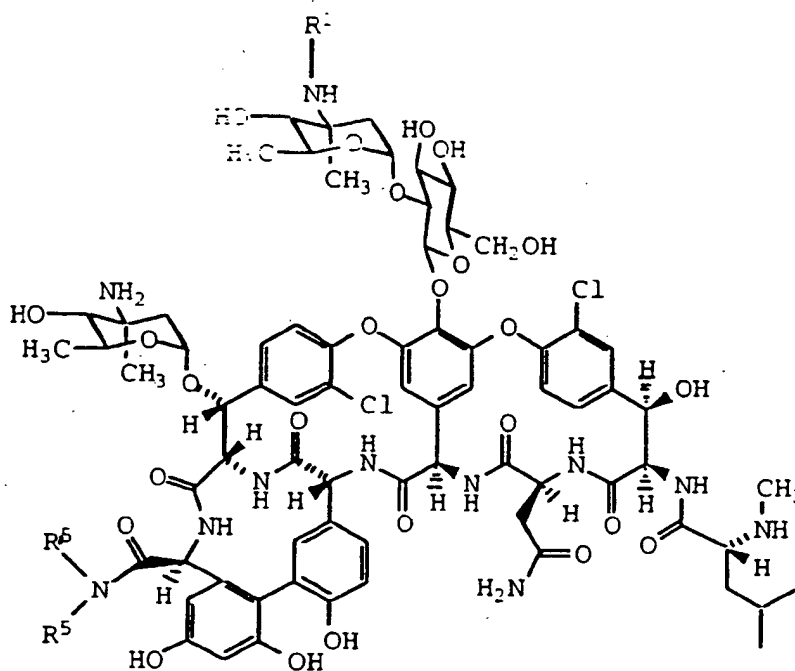
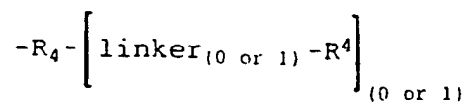
alkynyl of C<sub>2</sub>-C<sub>7</sub>-R<sup>3</sup>, or

alkyl of C<sub>1</sub>-C<sub>7</sub>-O-R<sup>3</sup>,

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wherein R<sup>3</sup> is a radical of the formula:

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cyano, loweralkoxy of C<sub>1</sub>-C<sub>4</sub>, haloloweralkyl of C<sub>1</sub>-C<sub>4</sub>, and haloloweralkoxy of C<sub>1</sub>-C<sub>4</sub>; and R<sup>7</sup> is

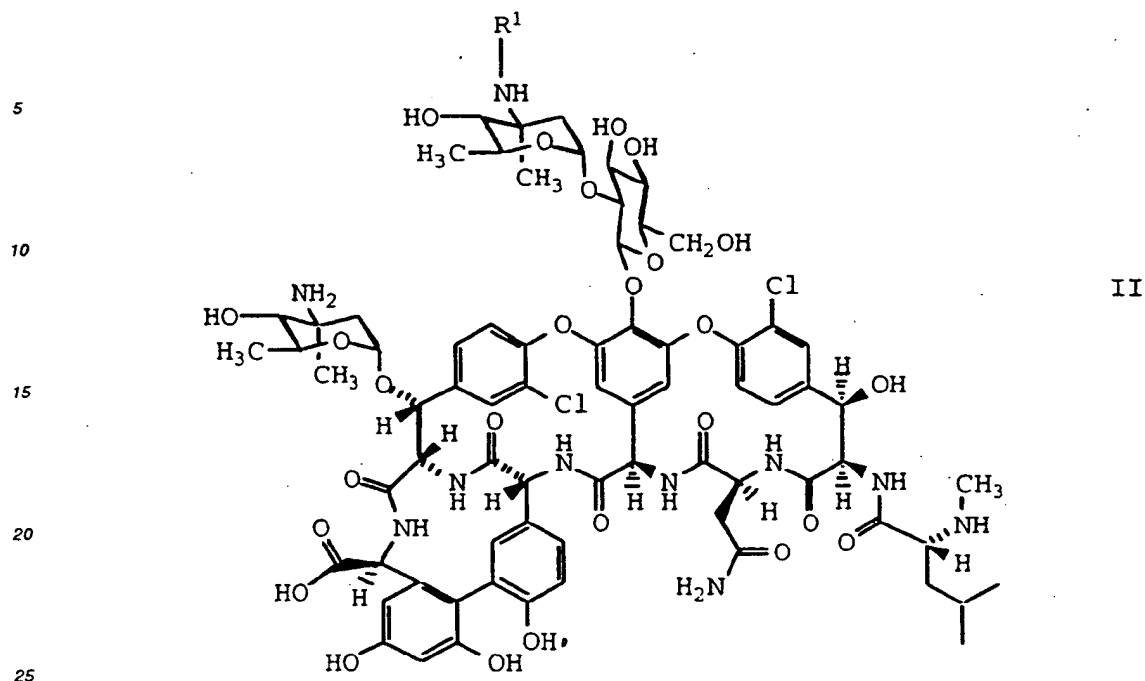


wherein each R<sup>8</sup> is independently hydrogen or loweralkyl of C<sub>1</sub>-C<sub>4</sub> or one R<sup>8</sup> is hydrogen and the other R<sup>8</sup> is tert-butoxycarbonyl, or R<sup>7</sup> is phenyl or substituted phenyl as defined above, or

(2) one R<sup>5</sup> is hydrogen and the other R<sup>5</sup> is (2-furanon-3-yl); or

(3) both R<sup>5</sup>s are taken together with the nitrogen and constitute a five- to seven-membered heterocyclic ring optionally containing in addition to the indicated nitrogen atom one additional hetero ring atom which is nitrogen, oxygen, or sulfur, and which heterocyclic radical can be unsubstituted or substituted with from one or two substituents, each of which is loweralkyl of C<sub>1</sub>-C<sub>2</sub>, loweralkoxy of C<sub>1</sub>-C<sub>2</sub>, phenyl, benzyl, or C<sub>1</sub>-C<sub>6</sub>-alkanoyl; or a salt thereof.

2. A compound of Claim 1 wherein R<sup>1</sup> is -CH<sub>2</sub>R<sup>2</sup> and R<sup>2</sup>=R<sup>3</sup>.
3. A compound of either of Claims 1-2 wherein R<sup>1</sup> is 4-phenylbenzyl.
4. A compound of either of Claims 1-2 wherein R<sup>1</sup> is 4-(4-chlorophenyl)benzyl.
5. A pharmaceutical formulation comprising a compound of any of Claims 1-4 in combination with a pharmaceutically-acceptable diluent or carrier.
6. A method of treating a bacterial infection in a host comprising the step of administering to the host an effective amount of a compound of any of Claims 1-4.
7. A method of Claim 6 wherein the bacterial infection is attributable to a vancomycin-resistant-enterococcus.
8. A compound of any of Claims 1-4 for use in antibacterial therapy.
9. A compound of any of Claims 1-4 for use in antibacterial therapy against vancomycin-resistant-enterococcus.
10. A process for the preparation of a compound of Claim 1 which comprises reacting a compound of Formula II,



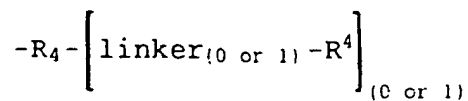
wherein R<sup>1</sup> is:

hydrogen or -CH<sub>2</sub>R<sup>2</sup>;

wherein R<sup>2</sup> is:

hydrogen,  
alkyl of C<sub>1</sub>-C<sub>15</sub>,  
alkenyl of C<sub>2</sub>-C<sub>15</sub>,  
alkynyl of C<sub>2</sub>-C<sub>15</sub>,  
haloalkyl of C<sub>1</sub>-C<sub>7</sub>,  
acenaphthenyl,  
2-fluorenyl,  
9,10-dihydro-2-phenanthrenyl,  
R<sup>3</sup>,  
alkyl of C<sub>1</sub>-C<sub>11</sub>-R<sup>3</sup>,  
alkenyl of C<sub>2</sub>-C<sub>7</sub>-R<sup>3</sup>,  
alkynyl of C<sub>2</sub>-C<sub>7</sub>-R<sup>3</sup>, or  
alkyl of C<sub>1</sub>-C<sub>7</sub>-O-R<sup>3</sup>,

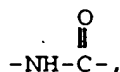
wherein R<sup>3</sup> is a radical of the formula:



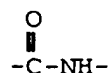
wherein each R<sup>4</sup> independently represents phenyl, cycloalkyl of C<sub>5</sub>-C<sub>6</sub>, naphthyl, or thienyl, each of which is unsubstituted or is optionally substituted with one or two substituents, each of which is independently alkyl of C<sub>1</sub>-C<sub>10</sub>, haloalkyl of C<sub>1</sub>-C<sub>2</sub>, haloalkoxy of C<sub>1</sub>-C<sub>2</sub>, alkoxy of C<sub>1</sub>-C<sub>10</sub>, halo, cyano, or nitro;

and "linker" is:

- alkylene of C<sub>1</sub>-C<sub>3</sub>,
- O-alkylene of C<sub>1</sub>-C<sub>6</sub>,
- 5 - alkylene of C<sub>1</sub>-C<sub>6</sub>-O-,
- O-,
- N(H or loweralkyl of C<sub>1</sub>-C<sub>3</sub>)-,
- S-,
- SO-,
- 10 - SO<sub>2</sub>-,

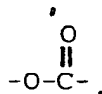


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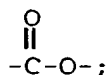
- 20 - CH=CH-,
- C≡C-,
- N=N-,

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or

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with an amine of the formula



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wherein R<sup>5</sup> is defined as follows:

(1) each R<sup>5</sup> independently represents

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- hydrogen,
- cycloalkyl of C<sub>5</sub>-C<sub>6</sub>,
- cycloalkenyl of C<sub>5</sub>-C<sub>6</sub>,
- phenyl or substituted phenyl bearing from one to three substituents, each of which is independently
- 50 halo,
- nitro,
- loweralkyl of C<sub>1</sub>-C<sub>4</sub>,
- cycloalkyl of C<sub>5</sub>-C<sub>6</sub>,
- loweralkoxy of C<sub>1</sub>-C<sub>4</sub>,
- 55 haloloweralkyl of C<sub>1</sub>-C<sub>4</sub>, or haloloweralkoxy of C<sub>1</sub>-C<sub>4</sub>;
- naphthyl,
- biphenyl,
- radical of the formula -R<sup>6</sup>-(R<sup>7</sup>)<sub>0, 1, or 2</sub>, wherein R<sup>6</sup> is loweralkyl of C<sub>1</sub>-C<sub>8</sub> optionally substituted by from



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one to three substituents, each of which is independently selected from the group consisting of halo, nitro, cyano, loweralkoxy of C<sub>1</sub>-C<sub>4</sub>, haloloweralkyl of C<sub>1</sub>-C<sub>4</sub>, and haloloweralkoxy of C<sub>1</sub>-C<sub>4</sub>; and R<sup>7</sup> is



wherein each R<sup>8</sup> is independently hydrogen or loweralkyl of C<sub>1</sub>-C<sub>4</sub> or one R<sup>8</sup> is hydrogen and the other R<sup>8</sup> is tert-butoxycarbonyl, or R<sup>7</sup> is phenyl or substituted phenyl as defined above, or

- (2) one R<sup>5</sup> is hydrogen and the other R<sup>5</sup> is (2-furanon-3-yl); or
- (3) both R<sup>5</sup>s are taken together with the nitrogen and constitute a five- to seven-membered heterocyclic ring optionally containing in addition to the indicated nitrogen atom one additional hetero ring atom which is nitrogen, oxygen, or sulfur, and which heterocyclic radical can be unsubstituted or substituted with from one or two substituents, each of which is loweralkyl of C<sub>1</sub>-C<sub>2</sub>, loweralkoxy of C<sub>1</sub>-C<sub>2</sub>, phenyl, benzyl, or C<sub>1</sub>-C<sub>6</sub>-alkanoyl; and optionally forming a salt thereof.

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# EUROPEAN SEARCH REPORT

Application Number  
EP 97 30 4495

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.6)
D,Y	EP 0 667 353 A (LILLY CO ELI) 16 August 1995 * the whole document *	1-10	C07K9/00 A61K38/14
Y	EP 0 435 503 A (LILLY CO ELI) 3 July 1991 * the whole document *	1-10	
			TECHNICAL FIELDS SEARCHED (Int.Cl.6)
			C07K
The present search report has been drawn up for all claims			
Place of search MUNICH		Date of completion of the search 25 August 1997	Examiner Deffner, C-A
<p><b>CATEGORY OF CITED DOCUMENTS</b></p> <p>X : particularly relevant if taken alone  Y : particularly relevant if combined with another document of the same category  A : technological background  O : non-written disclosure  P : intermediate document</p> <p>I : theory or principle underlying the invention  E : earlier patent document, but published on, or after the filing date  D : document cited in the application  I : document cited for other reasons  &amp; : member of the same patent family, corresponding document</p>			

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